Mercury Levels in Eggs of Colonial Waterbirds Nesting on the Great Lakes (1973-2002)

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Introduction

- Uptake and bio-accumulation of mercury can lead to adverse effects in birds:
  - impaired reproduction
  - chick mortality
  - behavioral alterations
  - inability to coordinate muscle movements
- Canadian Wildlife Service (CWS) monitors environmental contaminants in fish-eating birds nesting on the Great Lakes
  - Includes annual collections of Herring Gull (HERG) eggs from 15 colonies and periodic collections of eggs from other species

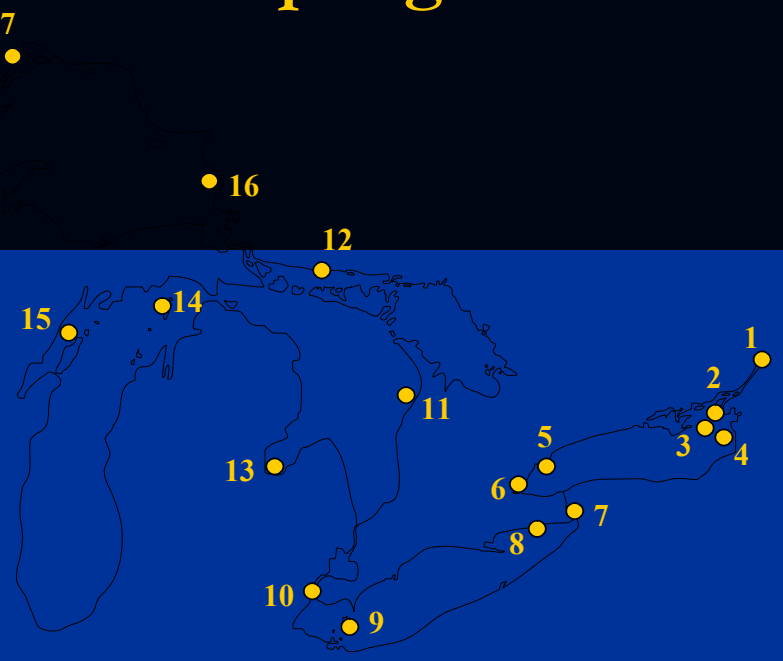
Objectives

- Present spatial and temporal trends of total mercury in HERG eggs
- Compare levels measured recently to those in other species

Methods

- HERG eggs collected annually from up to 15 colonies in the Great Lakes since 1973
- Black-crowned Night-Heron (BCNH) and HERG eggs collected from the same four colonies in 2000: Hamilton Harbour (LO), Niagara River, Middle Island (LE), Saginaw Bay (LH). Total mercury measured in egg contents pooled by species and site
- Great Black-backed Gull (GBBG) and HERG eggs collected from two nesting colonies in Eastern Lake Ontario in 2001. Total mercury measured in individual eggs

Location of Sampling Sites



1 St. Lawrence River
2 Eastern Lake Ontario
3 Pigeon I., Lake Ontario
4 Little Galloo I., Lake Ontario
5 Toronto Harbour
6 Hamilton Harbour
7 Niagara River
8 Eastern Lake Erie
9 Western Lake Erie
10 Detroit River
11 Eastern Lake Huron
12 Northern Lake Huron
13 Saginaw Bay, Lake Huron
14 Northern Lake Michigan
15 Western Lake Michigan
16 Eastern Lake Superior
17 Northern Lake Superior

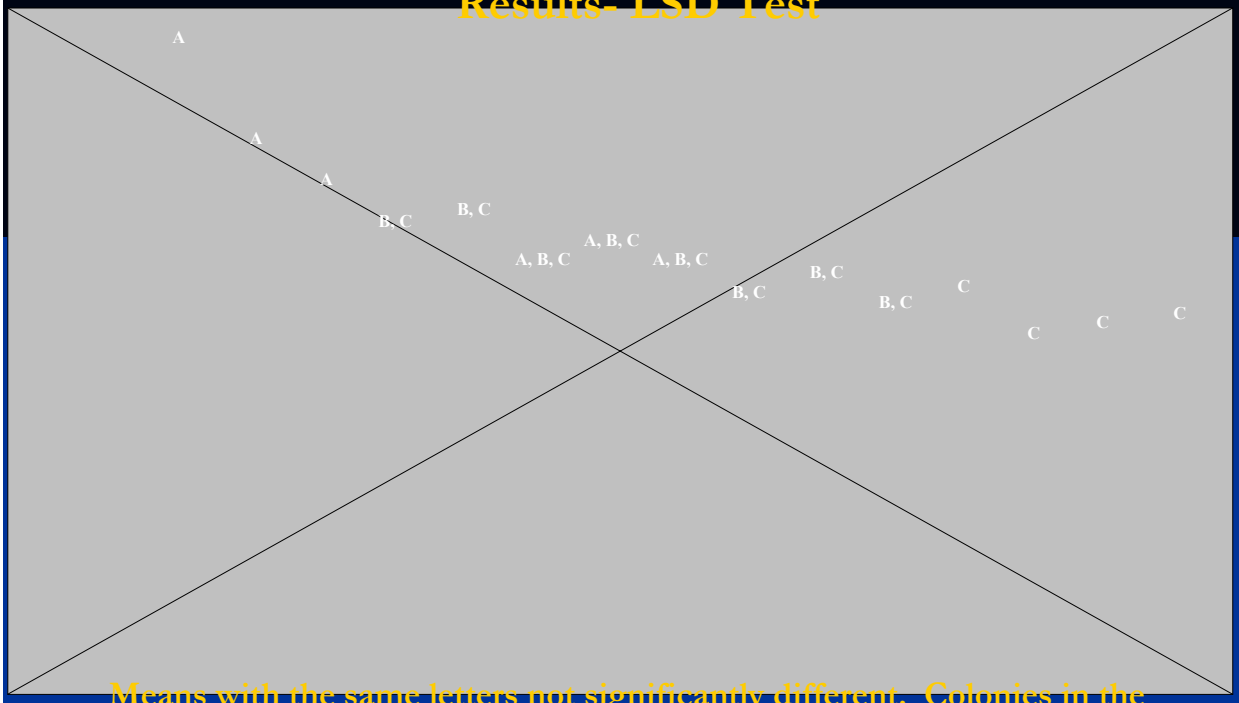
Methods- Statistical Analysis

- Data ln transformed
- Tests significant at alpha<0.05
- Spatial comparisons assessed for HERG eggs using last four years of data (1999-2002), with analysis of variance (ANOVA) and SNK and LSD post hoc tests
- Percent decrease from 1982 to 2002 determined for levels in HERG eggs from 15 annual monitoring colonies (except St. Lawrence River -assessed from 1986 to 2002)
- Temporal trends assessed by linear regression
- Between species comparisons assessed using t-tests

Spatial Trend - Total Mercury in HERG Eggs (1999-02)
Results- SNK Test

Error bars represent one standard deviation from the mean

Spatial Trend - Total Mercury in HERG Eggs (1999-02)
Results- LSD Test



Means with the same letters not significantly different. Colonies in the same spatial category shaded in the same color.

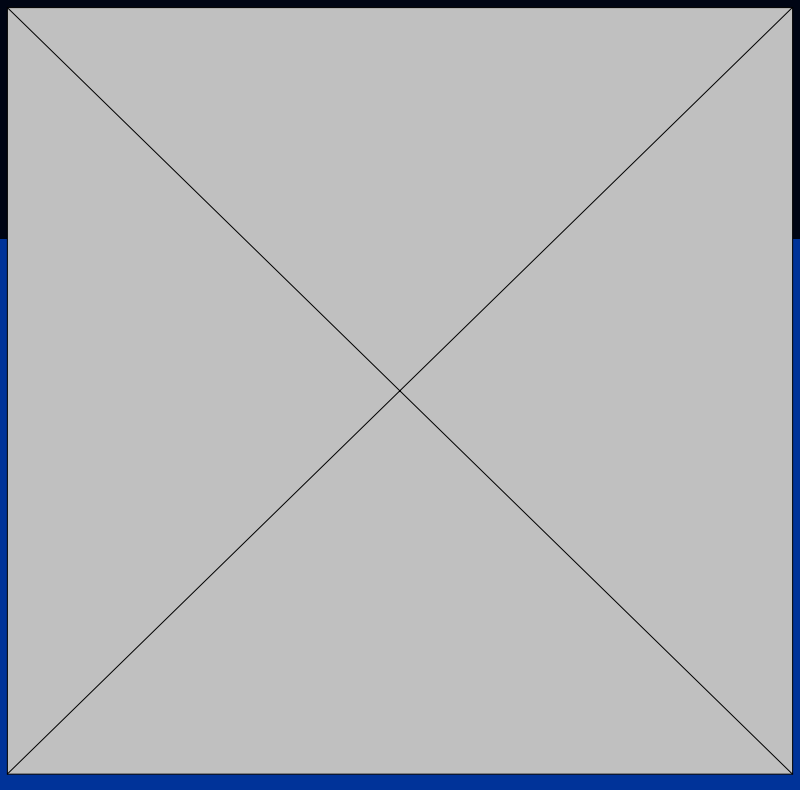
Temporal Trends (HERG)

- Total mercury levels declined significantly at most 73% (11/15) colonies
- Non-significant declines at three colonies
- Non-significant increasing trend at one colony (Saginaw Bay, Lake Huron)

Percent Decrease 1982-2002 (HERG)

- Greatest decreases (77 - 86 %) at E. Lake Erie, Toronto Harbour and E. Lake Michigan
- Smallest decreases (27 - 33 %) at Saginaw Bay, Detroit River, W. Lake Erie

Percent Decrease in Mercury Levels (1982-2002) & Results of Temporal Trend Analysis (1973-2002)

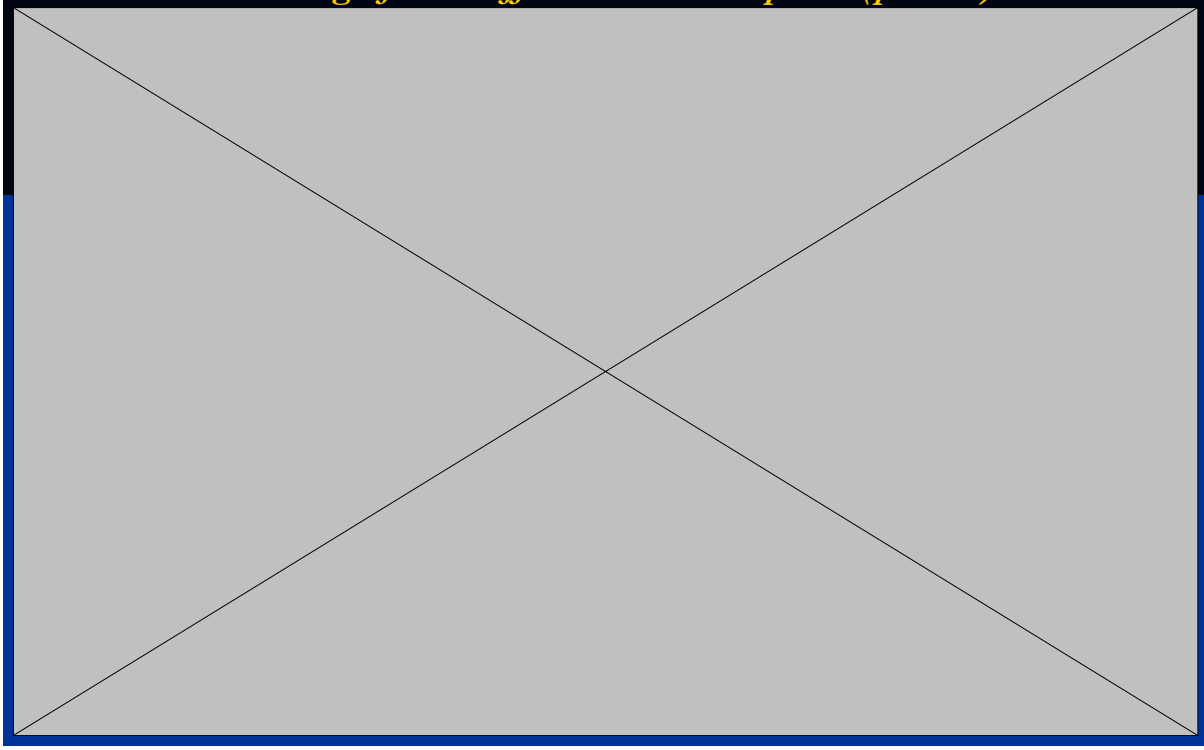


Comparisons Among Species BCNH & HERG

- In 2000, average levels 1.3 times higher in BCNH than HERG (p=0.28)
- Overall average for four colonies higher in BCNH
  - *Nonetheless* there were two colonies where levels higher in HERG than in BCNH (Saginaw Bay and Hamilton Harbour)

Average Mercury Levels in BCNH and HERG Eggs From Four Colonies (2000)

No significant difference between species (p=0.28)

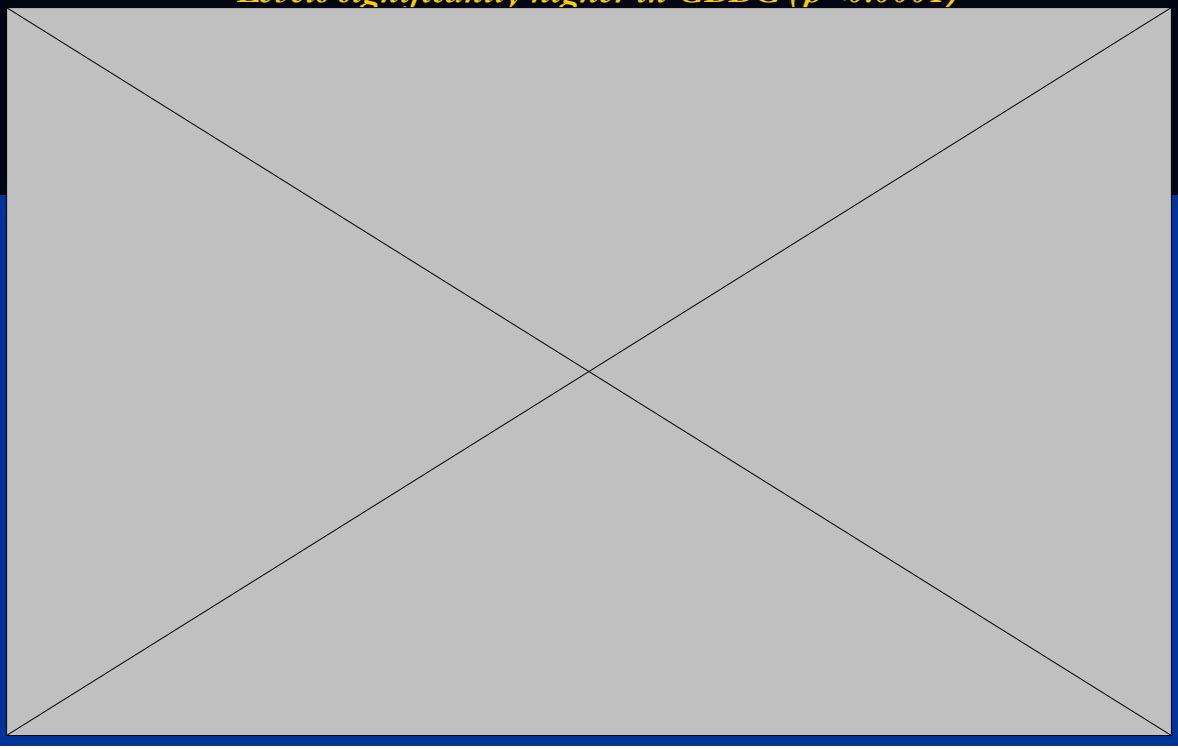


Comparisons Among Species GBBG & HERG

- In 2001 levels approximately 3x times higher in GBBG than HERG eggs (two colonies in Eastern Lake Ontario) ($p<0.0001$)

Average mercury levels in GBBG and HERG eggs (Two Eastern Lake Ontario colonies-2001)

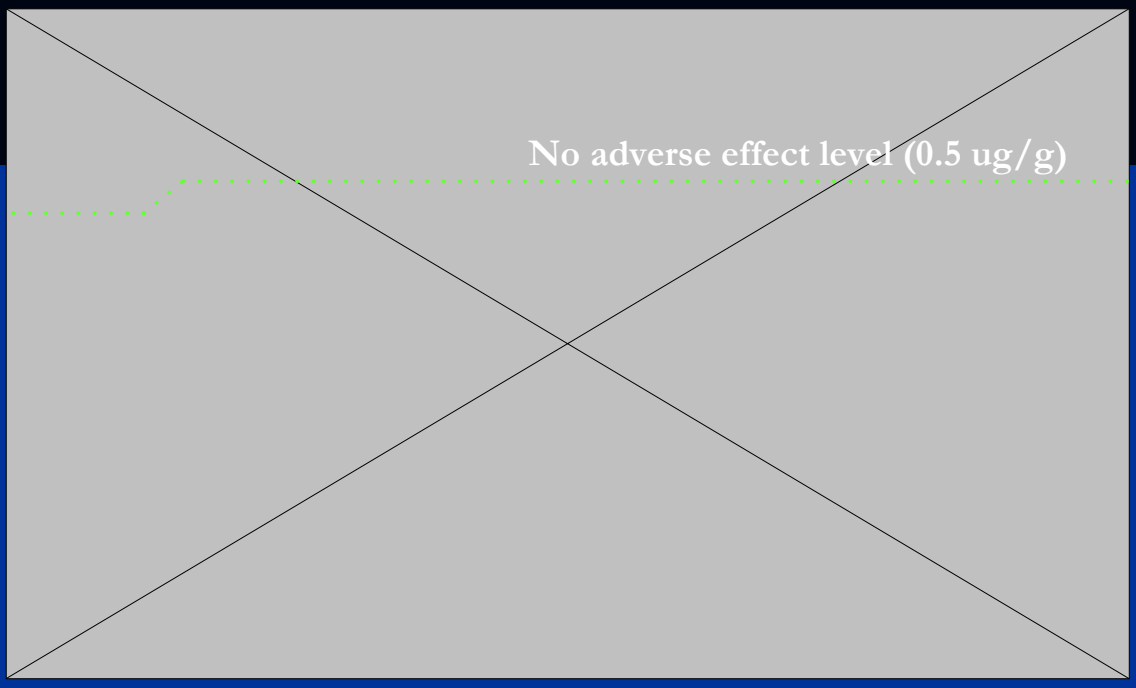
Levels significantly higher in GBBG ($p<0.0001$)



Adverse Effects

- Adverse effects reported in Red-tailed Hawks & Mallards at 0.5 ug/g ww (egg)
  - Impairments = decreased egg hatchability, deformities in chicks, behavioural alterations
- Levels in BCNH & HERG eggs below 0.5 ug/g ww
- Levels in GBBG eggs (E. Lake Ontario) slightly above 0.5 ug/g ww (0.64 ug/g)

Average Total Mercury Levels in GBBG, BCNH and HERG Eggs



Conclusions- HERG

- Spatial analysis (1999-2002)
  - Total mercury in HERG eggs highest in N. Lake Michigan, St. Lawrence River and E. Lake Ontario
- Temporal analysis
  - Since 1982 levels in HERG eggs decreased considerably (27-86%)
  - Significantly declining trends at most (73%) colonies from early 1970s or 1980s until 2002.

Conclusions- Comparing Among Species

- BCNH and GBBG higher average mercury levels than HERG eggs. Pattern not consistent for BCNH- levels higher in HERG at some colonies
- Current levels in BCNH and HERG eggs not high enough to elicit adverse effects
- Current levels in GBBG eggs slightly above no adverse effect level for two other avian species